

## Seven New Species of *Begonia* (Begoniaceae) From the Ulu Merirai and Bukit Sarang Limestone Areas in Sarawak, Borneo

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### Abstract

Seven new species are described from Sarawak, Borneo: two, *Begonia payung* S.Julia & Kiew and *B. sarangica* Kiew & S.Julia, are endemic to Bukit Sarang in Ulu Sungai Kakus, Tatau District; and five, *B. juliasangii* Kiew, *B. meriraiensis* S.Julia & Kiew, *B. nagaensis* Kiew & S.Julia, *B. piring* Kiew & S.Julia and *B. rhodochaeta* S.Julia & Kiew, are endemic in the Ulu Merirai area in the Tatau District.

### Introduction

Limestone hills in Sarawak, Borneo, are found majorly in the Kuching District (the Bau, Penrissen, and Padawan-Serian areas), and, distant from these, the Subis limestone (including the famous Niah Cave), the Mulu limestone of which Gunung Api rises to about 1,700 m and is the highest limestone peak in Malaysia, and the largely unknown limestone hills in the Tatau District, at Bukit Sarang and the Ulu Merirai area.

In Borneo, begonias that grow on limestone are diverse and endemism is high. For example, in Sabah, two thirds of the 18 species occur on just one limestone hill and almost a further third on hills within the same area (Kiew, 2001). Only one species, *Begonia gueritziana* Gibbs, is widespread and it is the only species that grows on other rock types besides limestone. Because of the many microhabitats available on limestone, frequently several begonias can be found on a single hill each occupying a different niche. In Sabah, up to four species were found on a single hill (Kiew, 1998).

A similar pattern is emerging for begonia diversity and distribution in Sarawak. In fact, limestone begonias are proving to be more species-rich than in Sabah. Already 28 species are recorded from Sarawak compared with 18 for Sabah. As in Sabah, begonia species are confined to one hill

or a group of hills. For example, five begonia species are recorded from the Subis limestone (Pearce, 2005); six from the Bau limestone (Kiew & Connie, 2003); and eight from each of the Penrissen and Padawan-Serian areas (Kiew & Julia, 2007). There are no begonia species in common between the Subis limestone and the rest of Sarawak. Of the 21 species in the Kuching District, only *B. speluncae* Ridl. occurs in the Bau, Penrissen, and Padawan-Serian areas, a third of the species are found in two of these three areas, but the majority (60%) are restricted to one of the three areas. As in Sabah, individual hills usually support more than one species (Kiew & Julia, 2007) with five species on Gunung Kawa (Bau limestone) and four each on G. Manok (Padawan-Serian limestone) and G. Bah (Penrissen limestone).

The surveys of the Bukit Sarang and Ulu Merirai begonias show similar high endemism and restricted distributions. The two begonias that grow on Bukit Sarang are found nowhere else as are the five from the Ulu Merirai.

Among begonias in Borneo, section *Petermannia* is the most speciose and the limestone begonias are no exception. The cane-like and creeping species belong to this section. Of the 28 species described from Sarawak limestone, 20 belong to this section. They grow at the base of the hills, or in gullies or on ledges on limestone derived soil, rather than on bare rock. One group among them is distinct for the strongly corrugate leaves, and is represented on all the hills, each with its own species – *B. congesta* Ridl. in Bau, *B. corrugata* Kiew & S. Julia in Padawan-Serian and Penrissen, *B. niahensis* K.G. Pearce on Subis, *B. sarangica* Kiew & S. Julia on Bukit Sarang, and *B. nagaensis* Kiew & S. Julia on Ulu Merirai.

The next most speciose section on limestone with six species is sect. *Reichenheimia* Group I of Doorenbos *et al.* (1998) that includes the peltate or orbicular-leaved species. These are characteristic of shaded sheer vertical cliff faces or around cave mouths. In the Kuching District, *B. speluncae* Ridl. is the most common and widespread; *B. payung* S. Julia & Kiew occurs on Bukit Sarang; and *B. juliasangii* Kiew on Ulu Merirai. (The Subis flora does not include a peltate begonia). *B. rhodochaeta* S. Julia & Kiew also belongs to this section even though it does not have peltate leaves.

Only two limestone species belong to sect. *Diploclinium* Group I of Doorenbos *et al.* (1998). One is *B. calcarea* Ridl. from the Kuching Division; the other is *B. piring* Kiew & S. Julia from Ulu Merirai. The latter is less usual for this section in having peltate leaves.

### Bukit Sarang

Bukit Sarang (02° 39' 12"N, 113° 03' 05"E) lies in Ulu Sungai Kakus in the Tatau District and includes two adjacent low hills: Batu Anyi (140 m at the summit) and Batu Lebik that is both smaller and slightly lower. Unlike most karst limestone, there are no sheer cliff faces, the hills being broken by narrow gullies deeply shaded and with a thick litter layer. These two hills are also unique for Bornean limestone, in being surrounded by freshwater swamp. Until our survey in October 2004 (Kiew *et al.*, 2007), the flora was very little known botanically having been visited only by J.A.R. Anderson in 1965, where in a day, he collected 25 herbarium specimens, including both the peltate and cane-like begonias, but which until this account have remained undescribed. Both species are endemic to the Bukit Sarang limestone and with just two species, this area is the least biodiverse of Sarawak limestone.

### Ulu Merirai

We surveyed the flora of the Ulu Merirai limestone in the Tatau District (02° 46' 13.7"N, 113° 39' 02.9"E) because it was said that Gunung Lumut, the largest hill in the area, was limestone. In fact it proved to be sandstone and the limestone in the area, rather than consisting of tower karst, was represented by exposed cliff faces on steep slopes, most below the tree canopy and only a few, Gua Aki Bukok, Gua Naga and Gua Tiang, rising sheer above the tree canopy to 430 m. Many of the caves are underground with their mouths more or less at ground level. During this trip, a total of nine limestone outcrops were surveyed.

This area proved to be more diverse than Bukit Sarang with five species discovered, all new species described below. All are endemic to the Ulu Merirai limestone. Only *B. nagaensis* was restricted to a single hill. Most hills supported just two species, only Gua Tiang had three.

Most striking were the two peltate species (*B. piring* Kiew & S.Julia with remarkable whitish green succulent circular leaves with a raised crimson rim, and *B. juliasangii* Kiew whose peltate leaves are unusual in being narrowly oval) and *B. nagaensis* Kiew & S.Julia, a cane-like begonia that had iridescent peacock-blue leaves.

## New Species

### 1. *Begonia juliasangii* Kiew, *sp. nov.*

Section: *Reichenheimia*

*A Begonia baramensi* Merr. *habitu rhizomatoso, alis fructus angustioribus 2.5-6 mm latis (nec 10-15 mm) et placentis in quoque loculo singulis differt.*

– **Typus:** Borneo, Sarawak, Tatau District, Ulu Merirai, trail to Gua Tiang, 6 Jul 2005, *Julia et al.* S 94658 (holo, SAR; iso E, KEP, SAR). **Plate 1A-C.**

Creeping herb climbing vertically for a short distance up cliffs and rocks, on soil decumbent and rooting at the nodes. **Stems** rhizomatous, glabrous, succulent, reddish brown, leafy stem up to 15 cm long and in life ca 1.3 cm thick; internodes 0.5-10 cm long; unbranched; without a tuber. **Stipules** greenish to pale reddish brown, glabrous, except for the sparsely hairy margin and outer surface of the midrib, ovate, 10-23 × 6-10 mm, margin entire, apex setose, persistent. **Leaves** spirally arranged, distant, laminae not oblique, pendent; petioles dark crimson to reddish brown or green, 7.5-13 cm long, terete, covered by translucent hairs up to 5 mm long; laminae plain matt dark green above, pale green beneath, young leaves bronze or pinkish above, pinkish beneath, glabrous, in life fleshy and succulent, drying papery, peltate, elliptic to obovate, slightly asymmetric with one side straight and the other slightly rounded, (15-)20-29 × (5-)7-9 cm long, broad side 3.5-5.5 cm wide, base rounded, peltate base very short, 5-6(-8) mm long, margin very shallowly and distantly crenate in the lower half, sometimes distinctly scalloped in upper half to one third of the lamina with a pointed lobe extending from the middle vein, apex acuminate; venation palmate-pinnate with a basal pair and 2-3 pairs along the midrib with 2 minute veins in the peltate base, prominent on both surfaces, main veins concolorous above, paler green and sparsely hairy beneath. **Inflorescences** axillary, crimson, glabrous, erect, very slender, 2.5-4.5 cm long and shorter than petioles, a simple or once branched cyme, in twos from the lower leaf axils; male flowers 4 or 9 and female flowers 2 at base; peduncles 2-2.5 cm long, male branches ca 7.5 mm long, female branch 5-13 mm long. Bracts clustered at the base, crimson, lanceolate, 5-7 × 2-3 mm, glabrous, margin entire, apex setose, persistent; bracteoles in pairs, similar to bracts but smaller, 2-3 × 1-2 mm. **Male flowers** with a crimson pedicel, 23-26 mm long; tepals 4, white at the base, deep pink along margin towards the apex, almost equal in size, glabrous, ovate, margin entire, apex acute; outer tepals 11-13 × 9-10 mm, inner tepals similar but slightly smaller, 9-10 × 6-7 mm; stamens 30-35,



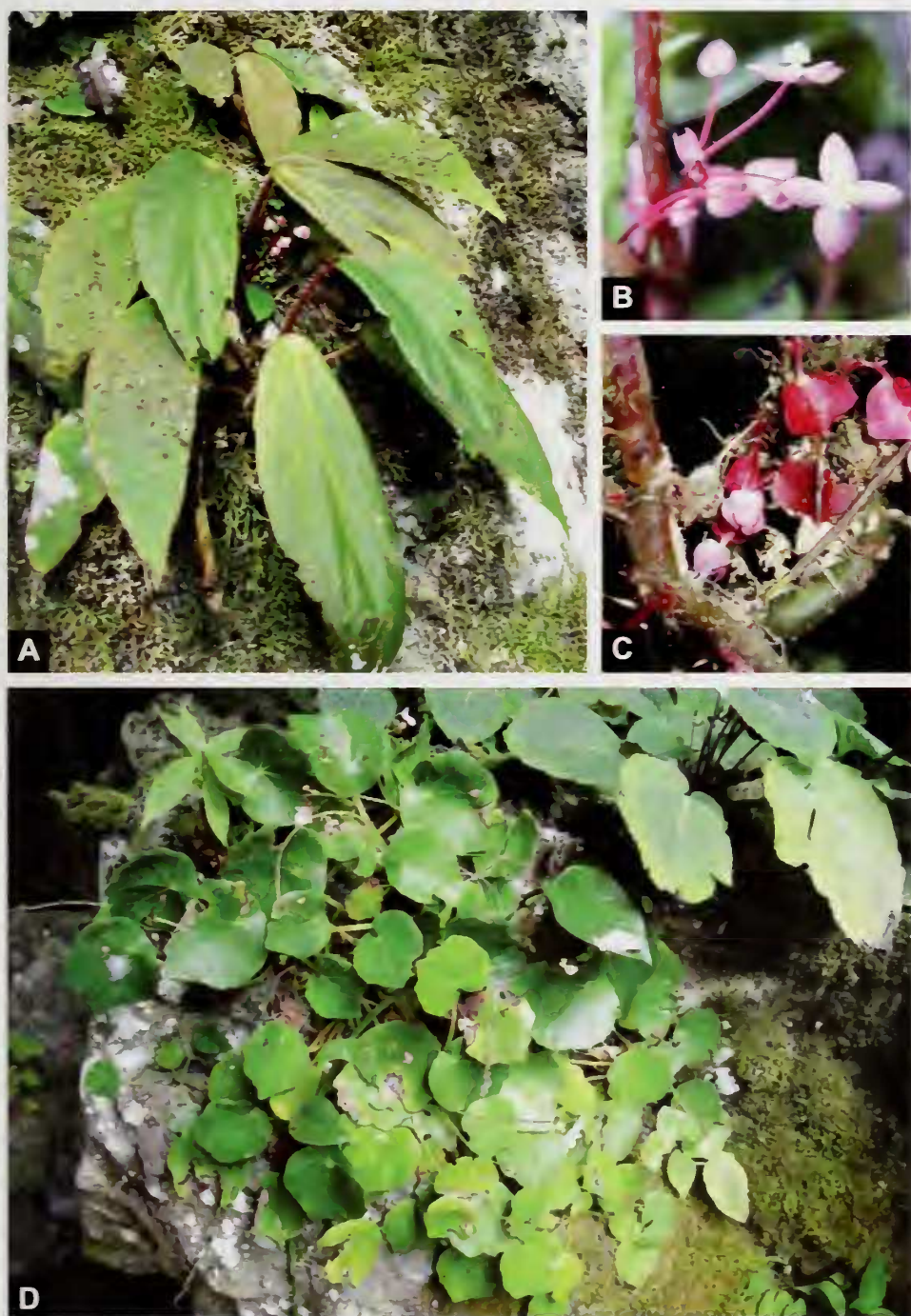


Plate 1. *Begonia juliasangii* Kiew. A. Habit; B. Male flowers; C. Female flowers. *Begonia payung* S. Julia & Kiew. D. Habit. (Photos: J. Sang).

cluster hemispherical, ca 4 mm diam., stalk ca 1 mm long; filaments pale yellow, ca 1.2 mm long; anthers pale yellow, ellipsoid, ca 1.2 mm long, apex slightly emarginate, dehiscing along lateral slits. **Female flowers** with glabrous, rosy red pedicels 2-5 mm long; ovary light crimson, broadly obovate, 8-10 × 9-10 mm, wings 3 (rarely 4), equal, locules 3, placentas 1 per locule; tepals 5, isomorphic, white at the base and rosy red along the margin, elliptic, ca 7 × 5-6 mm, margin entire, apex slightly acute; styles and stigmas ca 2 mm long, styles 3, yellow, bifurcating and U-shaped; stigmas forming a continuous twisted band. **Fruits** on the lower part of the stem, pendent; peduncle and pedicel slender 1.7-3 cm long; capsules deep crimson, glabrous, ovoid, 16-18 × 10-19 mm, wings 3, equal, narrow, 2.5-6 mm wide and tapering to the base and apex, thinly fibrous, dehiscing between locules and wings. **Seeds** barrel-shaped, ca 0.3 mm long, collar cells ca 4/5 seed length.

*Other specimens examined:* Borneo. Ulu Merirai. Gua Tiang, *Malcom et al.* S 95535 (SAR); above Gua Pak Danum, 12 Jul 2005, *Leong et al.* PL 314 (SAR, SING).

*Habitat:* Restricted to limestone, on the base of vertical, deeply shaded cliffs or within cave mouths or sometimes rooting in soil at the cliff base.

*Distribution:* Endemic in Borneo, Sarawak; known only from the Ulu Merirai area in Tatau District.

*Notes:* This is a very distinct begonia, quite unlike any other Bornean limestone species in its elliptic, scarcely peltate leaves. Other limestone peltate species have almost rotund leaves with the petiole attached towards the centre of the lamina. In its elliptic to obovate peltate leaves, it most resembles *Begonia baramanesis* Merr. but otherwise it is quite different because *B. baramanesis* is a cane-like begonia to 60 cm tall (not creeping), the leaves are shorter and distinctly oblique with petioles 2.5-4.5 cm long and lamina 10-17.5 cm long. In addition, the peltate base is more pronounced being 2.5-4.5 cm long. The fruit too is very different in being large (16-25 × 28 mm) and having downward pointing wings 10-15 mm wide. In addition, *B. baramanesis* is placed in a different section, sect. *Petermannia*, because it has three locules each with two (not one) placentas. (Doorenbos *et al.* were doubtful as to its placement in sect. *Petermannia* but dissection of the ovary of S 31503 confirms its position).

The species is named for Julia Sang, who first discovered this begonia.

**2. *Begonia meriraiensis* S. Julia & Kiew, sp. nov.**Section: *Petermannia*

*A Begonia paoana* Kiew & S. Julia inflorescentiis brevioribus 9-10 cm longis (nec 11-25 cm), fructibus angustioribus 14-20 mm latis (nec 21-25 mm) et pedicellis in fructu 5-10 mm longis (nec 10-23 mm) differt. – **Typus:** Borneo, Sarawak, Tatau District, Ulu Merirai, Gua Tiang 6 Jul 2005 Julia et al. S 94657 (holo SAR; iso E, KEP, SAN, SAR, SING, K, L).

Shrubby cane-like begonia, densely hairy, hairs 3 mm long. **Stems** ferruginous, erect, woody, to 75 cm tall, in life 8 mm thick, 4 mm thick when dried; internodes 3-5.7-8.5 cm long; without a tuber. **Stipules** light green, broadly triangular, 17 × 8-10 mm, margin entire, apex acute, caducous. **Leaves** spirally arranged, distant, held horizontally; petioles ferruginous, 1-1.7(-3.2) cm long, terete; laminae scarcely oblique, plain glossy dark green above, light green below, in life corrugate and thinly succulent, papery when dried, broadly oval to slightly ovate on the broad side, scarcely asymmetrical, (14-)18.5-20(-25.5) × (8-)10-12(-15) cm, broad side (5-)6.5-7.5(-9.5) cm, base unequal, basal lobe rounded sometimes auriculate, 1-2.5 cm long, margin minutely and distantly toothed at the veins ending, apex caudate, acumen 0.5-2 cm long; venation palmate-pinnate, veins concolorous, ferruginous beneath, 1-2 pairs at the base, 4-5(-6) pairs along the midrib, 2 veins in the basal lobe, branching three times, in life deeply impressed above, slightly raised when dried, prominent below. **Inflorescences** axillary from the upper leaf axils, racemose, hairy, erect, up to 9-10 cm long, beginning to flower at ca 2 cm long; peduncles stout, ca 2.5 mm thick, reddish to brownish, 2-3 cm long, branches up to 0.5 cm long and 1-2 cm apart, above male flowers many, below female flowers 2, protogynous. Bracts ferruginous, 10-13 × 5-8 mm; bracteoles yellowish green. **Male flowers** with densely and minutely hairy pedicels, 3-8 mm long; tepals 2, outside rosy red and densely and minutely hairy, inside greenish cream and glabrous, oval to round, 4-6 × 4-6 mm, recurved when open, margin entire, apex acute to rounded; stamens ca 35, stamen cluster conical, subsessile, stalk ca 0.5 mm long; filaments 0.5-0.7 mm long; anthers dull yellow, obovate, ca 0.7 mm long, apex rounded, dehiscing along lateral slits. **Female flowers** with minutely hairy pedicels, 4-7 mm long; ovary pale green, minutely hairy, ellipsoid, ca 18 × 10-12 mm, wings 3, equal, locules 3, placentas 2 per locule; tepals 5 almost isomorphic, pale green, pinkish at base, minutely hairy outside, ovate, 9-12 × 7-9 mm, toothed towards the apex; styles 3, lemon-yellow, 5-6 mm long, bifurcating, stigmas forming a spiral papillose band. **Fruits** pendent on thick stalks 7-10



mm long, capsules narrowly oblong, narrowed to base, 20-28 × 14-20 mm, wings 3 (rarely 4), equal, truncate distally, 5-10 mm wide, glabrous, thinly fibrous, dehiscing between the locules and wings. **Seeds** barrel-shaped, 0.3 mm long, collar cells more than half the seed length.

*Other specimens examined:* Borneo, Sarawak, Ulu Merirai. Gua Aki Bukok, *Malcom et al. S 95606* (E, KEP, SAR, SING); *ibid*, *Malcom et al. S 95631* (SAR); Gua Naga, 11 Jul 2005, *Leong et al. PL 278* (SAR, SING).

*Habitat:* Extremely common from the lower to upper slopes in limestone forest, on calcareous soil as well as on litter-covered limestone rocks.

*Distribution:* Endemic in Borneo, Sarawak; known only from the Ulu Merirai area in Tatau District.

*Notes:* *Begonia meriraiensis* is the most common and widespread limestone species found in Ulu Merirai area, so is named for this locality. It is a cane-like begonia similar to *B. paoana* Kiew & S. Julia from limestone in the Kuching Division, but from which it can be distinguished by the following characters (see Table 1).

**Table 1.** A comparison of *Begonia meriraiensis* and *B. paoana*.

	<i>B. meriraiensis</i>	<i>B. paoana</i>
Stem	densely hairy (hairs to 3 mm long)	minutely pubescent
-Stem diam.	8 mm	3-4 mm
Stipule	triangular	obovate
Lamina	14-25.5 × 8-15 cm (length:width = <2×)	15-24 × 4.5-11 cm (length:width = >2×)
Basal lobe	rounded, sometimes auriculate 1-2.5 cm long	rounded 0.5-1.3 cm long
Apex	caudate	acuminate
Veins	ferrugineous	glabrous/minutely pubescent
Inflorescences	9-10 cm long	11-25 cm long
Bracts	ferrugineous, 10-13 × 5-8 mm	glabrous, 7 × 3 mm
Male flower	pedicel pubescent tepals minutely hairy	pedicel glabrous tepals glabrous
Female flower	ovary minutely hairy	ovary glabrous
-Tepals	7-9 mm wide	4-6 mm wide
-Style	5-6 mm long	3-4 mm long
Fruits	pedicels 5-10 mm long capsule 14-20 mm wide	pedicels 10-23 mm long capsule 21-25 mm wide



### 3. *Begonia nagaensis* Kiew & S. Julia, *sp. nov.*

Section: *Petermannia*

*A Begonia corrugata* Kiew & S. Julia *foliis cyaneis (colore pennarum pavonis) 8.5-9 cm latis (nec 9-16 cm), inflorescentiis brevioribus 4-6 cm longis (nec 13.5-23 cm) et fructibus ca 14 × 12 mm (nec 9-16 mm) differt.*

– **Typus:** Borneo, Sarawak, Tatau District, Ulu Merirai, Gua Naga, 11 Jul 2005, Leong *et al.* PL 290 (holo, SAR; iso, SING). **Plate 2A-B.**

Cane-like begonia. **Stems** dull green, erect with a few branches, up to 75 cm tall, 4 mm thick, bristly, bristles red when young, brown when old, woody, sometimes thicker at the nodes, internodes 5.5-6 cm long; without a tuber. **Stipules** pale green; densely hairy along the midrib, lanceolate, 9-25 × 8-10 mm, midrib densely hairy, margin entire, apex setose with the apical hair up to 10 mm long, caducous. **Leaves** alternate, distant, slightly pendent; petioles reddish with long bristles, 2-2.5 cm long, grooved above; laminae slightly oblique to oblique, plain iridescent blue and velvety above with a red patch at the base of the midrib, young leaves purple green above and purple beneath, thin and corrugate in life, elliptic, asymmetric, 17.5-19 × 8.5-9 cm, broad side 5.5-6 cm wide, base cordate with rounded basal lobes 1.5-2 cm long, margin minutely dentate, each tooth tipped by a hair, apex acuminate, acumen 0.75-1 cm long; venation palmate-pinnate, main veins slightly reddish and hairy beneath, 2 pairs at the base, 3-5 pairs along the midrib and 3 veins in the basal lobe, equal-sized, branching towards the margin, impressed above and prominent beneath. **Inflorescences** axillary, reddish or reddish brown with bristly red hairs ca 2 mm long, racemose with cymes of male flowers spaced along the rachis and with 1 or 2 female flowers below, erect, longer than the petioles, 4-6 cm long, sessile or with peduncles up to 1.3 cm long, protogynous. Bract pair pale green, ovate, ca 10 × 6 mm, margin entire, apiculate; bracteoles pale green, hairy, elliptic, ca 3 × 1.5 mm, margin entire, apex apiculate, caducous. **Male flowers** with a glabrous, red pedicel 2-6 mm long; tepals 2, reddish with red hairs outside, light pink inside, almost round, 4-5 × 3.5-4 mm, margin entire and recurved, apex rounded; stamens ca 30, stamen cluster sessile, globose, 2.5-3 mm across; filaments ca 0.75 mm long; anthers pale yellow, obovate, ca 1 mm long, apex emarginate, dehiscing along lateral slits. **Female flowers** with a red to dark red, densely hairy pedicel ca 12 mm long; ovary fleshy, reddish green, locules densely covered with dark red hairs on the locules (not on the wings), broadly ellipsoid, ca 20 × 15 mm, wings 3, equal, 2.5-3 mm wide, locules 3, placentas 2 per locule; tepals 5, covered with red hairs outside and on the margin, light pink, elliptic, outermost ca 15 × 8 mm, innermost

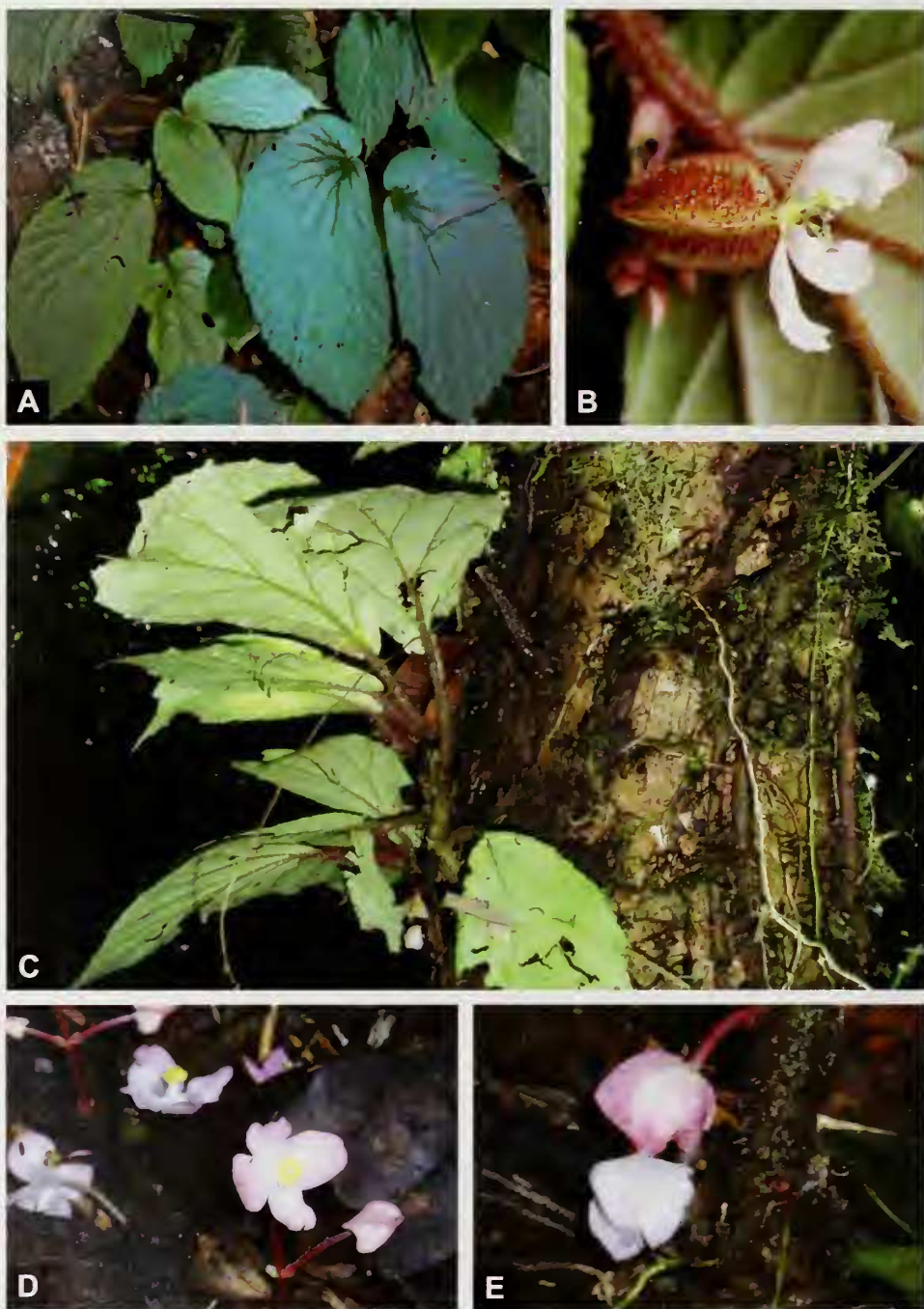


Plate 2. *Begonia nagaensis* Kiew & S.Julia. A. Habit; B. Female flowers. *Begonia rhodochaeta* S.Julia & Kiew. C. Habit; D. Male flower; E. Female flower. (Photos: J. Sang).

ca  $10 \times 4$  mm, margin entire, apex acute; styles 3, bifurcating, ultimate branches spirally twisted, ca 5 mm long; stigmas forming a papillose spiral twisted band. **Fruits** 1 or 2 per infructescence, pendent on a pale green, stiff, minutely bristly stalk 12-13 mm long, capsules green with long red hairs especially dense on the locule wall; ellipsoid, ca  $14 \times 12$  mm, wings 3, equal, tapered to the base, slightly angled distally, ca 3 mm wide, thinly fibrous, dehiscing between the locules and wings. **Seeds** barrel-shaped, brown, ca 0.25 mm long, collar cells about 4/5 of the seed length.

*Specimen examined:* Known only from the type specimen.

*Habitat:* In limestone forest on a ledge above a steep slope at the base of cliff face, on soil in light shade.

*Distribution:* Endemic in Borneo, Sarawak; known only from Gua Naga above Sungai Bekuyat in Ulu Merirai area, Tatau District.

*Notes:* *Begonia nagaensis* is very local and was found at only one locality, Gua Naga, for which it is named. The other begonias were found at two or more localities.

This species can be easily recognised by its striking iridescent leaves that like peacock feathers change from blue to bright green depending on the angle of the light. It also has conspicuous dark red hairs on the male and female flowers.

It is a cane-like begonia with corrugated leaves that, apart from its peacock-blue leaves and capsule with red hairs, can be distinguished from *B. corrugata* Kiew & S. Julia from the Kuching Division by its broader lamina (8.5-9 cm vs. 9-16 cm), shorter inflorescences (4-6 cm not 13.5-23 cm long) and smaller capsule ( $14 \times 12$  mm not  $15-20 \times 12-15$  mm).

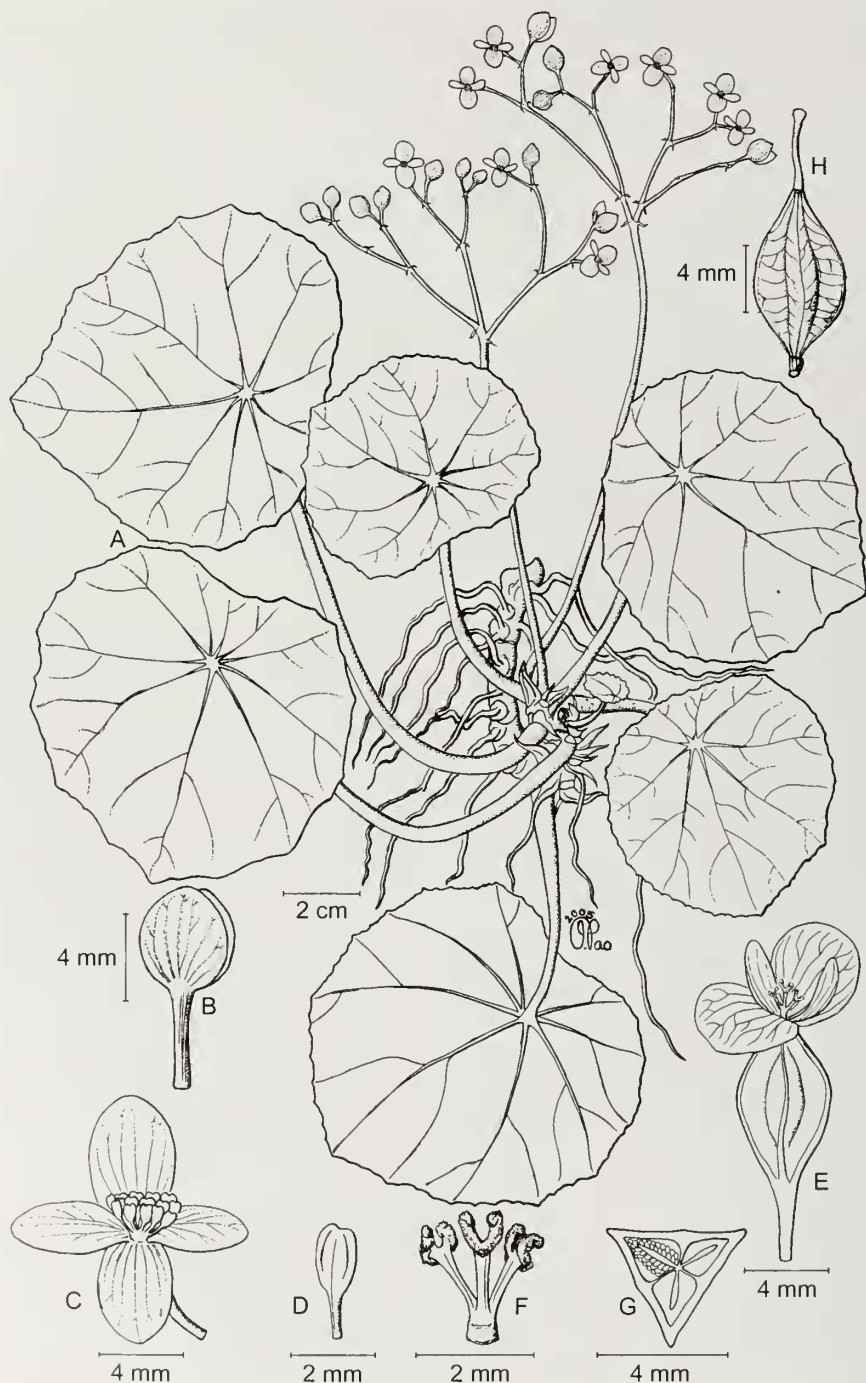
#### 4. *Begonia payung* S. Julia & Kiew, *sp. nov.*

Section: *Reichenheimia*

*A Begonia speluncae* Ridl. *petiolis longioribus 10-18 cm longis (nec usque 7 cm), foliis latioribus 6-11 cm latis (nec 4(-6) cm) et fructibus alis carentibus differt.* – **Typus:** Borneo, Sarawak, Tatau District, Ulu Sungai Kakus, Bukit Sarang, Batu Anyi, 5 Oct 2004, *Lee et al.* SL 38 (holo, SAR; iso, SING). **Fig. 1, Plate 1D.**

Small, creeping begonia, whole plant glabrous. **Stems** rhizomatous and rooting at the nodes, young stem succulent and pale green becoming





**Figure 1.** *Begonia payung* S. Julia & Kiew. A. Habit; B. Male flower bud; C. Male flower; D. Stamen; E. Female flower; F. Styles and stigmas; G. Transverse section of ovary; H. Fruit. (Drawing by J. Pao).



brown and woody, little branched, up to 11 cm long, in life 5-6 mm thick; without a tuber. **Stipules** reddish, narrowly lanceolate,  $5-7 \times 4$  mm, margin slightly toothed, apex setose, persistent. **Leaves** up to 4-5 mm apart, spreading over the cliff face; petioles pale green, 10-18 cm long, terete; laminae sometimes bronzy green when young, mature leaves plain matt dark green, in life thickly succulent, papery when dried, peltate, broadly ovate, almost symmetric,  $5-8.5 \times 6-11$  cm, broad side 2.7-5.5 cm wide, base rounded and 1.5-2.5 cm long, margin crenate, apex acute; venation palmate-pinnate, 3 pairs at the base with one pair along the midrib, and one pair in the peltate base, branching ca two thirds of the way to the margin, slightly raised above, impressed beneath, pale green, sometimes bronzy green. **Inflorescences** axillary, whitish green, erect, longer than the leaves, cymose panicles, (12.5-)15.5-20 cm long with two main branches 0.5-1 cm long, male flowers 5 to 11, female flowers 2 or 4, protandrous. Bracts brownish, ovate, apex pointed, ca  $10 \times 3$  mm, margin entire, persistent, bracteoles similar but smaller, ca  $5 \times 3$  mm. **Male flowers** with pale pink pedicels 10-16 mm long; tepals 4, margin entire, apex rounded or slightly acute, outer two, rosy pink outside, pale pink inside, rotund,  $6-9 \times 6-10$  mm, inner two pale pink inside and out, narrowly obovate or oval, (4-)7-10  $\times$  2-3 mm; stamens ca 25, stamen cluster fan-shaped,  $2.5-5 \times 4-5$  mm, stalk ca 1 mm long, filaments ca 1.5 mm long, anthers pale yellow, narrowly obovate, ca 1.5 mm long, apex emarginate, dehiscing along lateral slits. **Female flowers** with reddish pedicels ca 5 mm long; ovary pale pink, rhomboid,  $7-8 \times 5-9$  mm, 3-angled in cross section, without wings but with a deep pink rib ca 0.5 mm wide along the angle of the ovary, locules 3, placenta 1 per locule; tepals 5, margin entire, apex rounded, outer two rotund, deep pink outside, pale pink inside,  $7-8 \times 6$  mm, inner three oblong, white, ca  $4 \times 2$  mm; styles 3, bifurcating and U-shaped, styles and stigmas pale yellow, 3-4.5 mm long, stigmas forming a spiral papillose band. **Fruits** dangling on fine and hair-like stalks 3-4 mm long, capsules  $7-10 \times 5-6$  mm, locules 3, three-angled but without wings, ribs ca 1 mm wide, splitting between the locules and the rib. **Seeds** brown, barrel-shaped, ca 0.25-0.3 mm long, collar cells more than half the seed length.

*Other specimen examined:* Borneo. Ulu Sungai Kakus, Bukit Sarang, 14 Mar 1965, *Anderson S 20958* (SAR).

*Habitat:* Vertical limestone cliffs in light or deep shade, common.

*Distribution:* Endemic in Borneo, Sarawak, known only from Ulu Sungai Kakus, Bukit Sarang (Batu Anyi and Batu Lebik) in the Tatau District.

*Notes:* *Begonia speluncae* Ridl., from the Kuching Division, also has peltate leaves and belongs to sect. *Reichenheimia*. However, it differs from *B. payung* in being a diminutive plant with orbicular leaves up to 4 (rarely 6) cm across and with petioles up to 7 cm long. In addition, the wingless capsules of *B. payung* are most unusual among Bornean begonias that in general have winged capsules or exceptionally have fleshy indehiscent berries. In *B. payung*, the wings are reduced to a narrow rib less than 1 mm wide at the extremities of the angular fruit. In contrast, *B. speluncae* has capsules with distinct wings.

We have named this species *Begonia payung* (*payung* is the Malay word for umbrella) in reference to its round peltate leaf. [Anderson S20958 (SAR) was annotated as *Begonia laxiflora* by Irmscher, but this name was never published].

5. *Begonia piring* Kiew & S. Julia, *sp. nov.*

Section: *Diploclinium*

*A Begonia payung* S. Julia & Kiew internodiis longioribus 12-35 mm longis (nec 4-5 mm), marginibus folii coccinei, fructibus subsessilibus trialatis et placentis bifidis differt. – **Typus:** Borneo, Sarawak, Tatau District, Ulu Merirai, Sungai Bekuyat, Gua Aki Bukok, 10 Jul 2005, Julia et al. S 91200 (holo, SAR, iso, AAU, E, K, L, MO, SAN, SAR, SING). **Plate 3A-E.**

Rhizomatous, glabrous begonia. **Stems** creeping and rooting on vertical cliff faces; succulent, pale green, almost translucent, brittle in life, up to 30 cm long and 5 mm thick, internodes 1.25-3.5 cm long; without a tuber. **Stipules** pale green; broadly triangular, 8-16 × 4-6 mm, margin entire, apex acute to apiculate, persistent. **Leaves** slightly spirally arranged, distant, pendent; petioles pale green, translucent, 10.5-17.5 cm long, grooved above; laminae oblique, plain whitish green, surface scintillating, succulent and brittle in life, tissue paper thin when dried, peltate, broadly elliptic, slightly asymmetrical, 7-10 × 8-10 cm, broad side 5-6.5 cm, base rounded, projecting 0.5-1.5 cm beyond petiole attachment, margin crimson, undulate or scalloped and acute at the vein endings, apex acute; venation palmate-pinnate, main veins slightly paler than the lamina, 2 pairs at the base of and 4 pairs along the midrib, 1 pair in the base, plane above, slightly prominent beneath. **Inflorescences** axillary, crimson, cymose panicles branched 4 or more times, erect, as long as the petioles, 18.5-33.5 cm long, peduncle succulent, 7.5-12 cm long and ca 5 mm thick, male flowers many on the upper branches, female flowers 2 below on a branch 2.2-3.5 cm long, protandrous. Bract pairs pale green, obovate, 10-11 × 4 mm, margin entire,

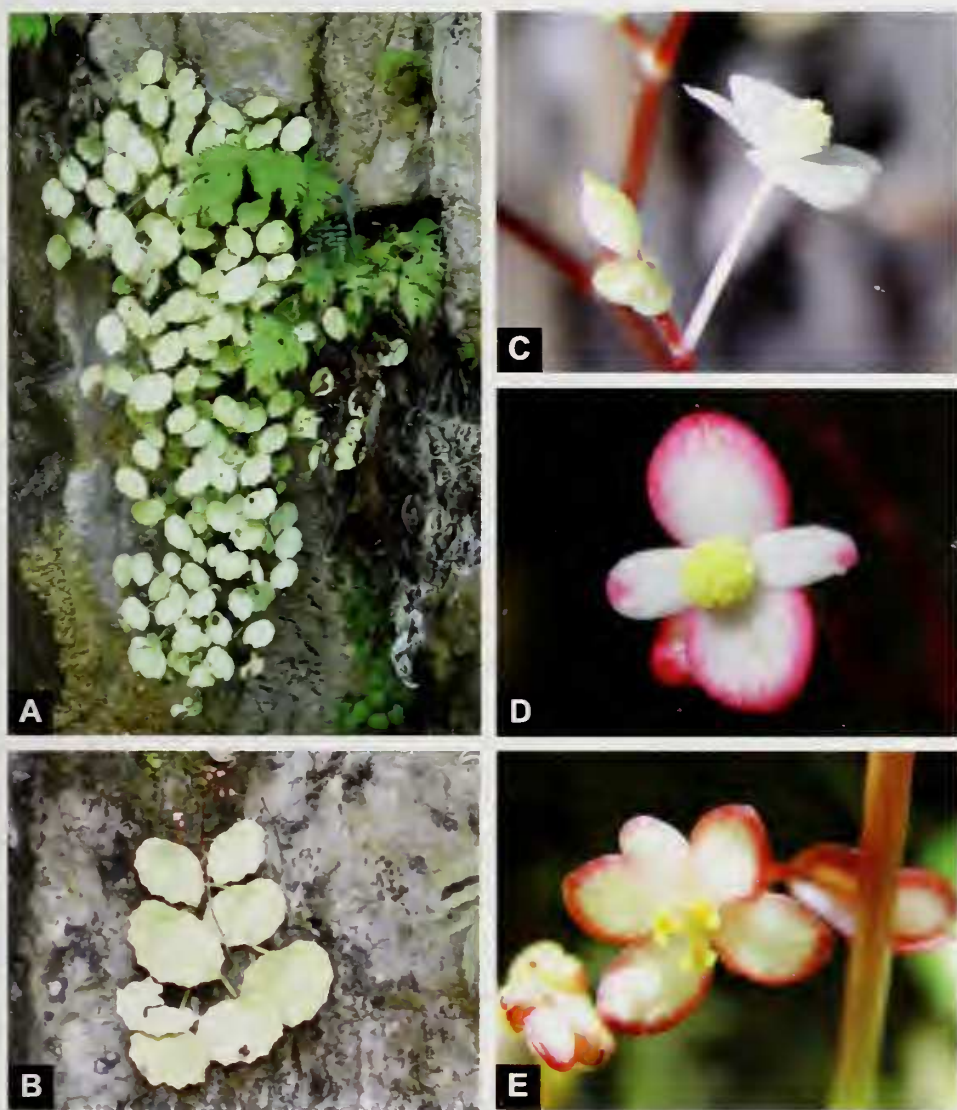


Plate 3. *Begonia piring* Kiew & S. Julia. A. Habit; B. Leaf; C. Male flowers; D. Close up of a male flower; E. Female flower. (Photos: J. Sang).

apex broadly truncate or rounded, caducous; bracteole pairs similar to bracts but smaller,  $3-7 \times 1.5-2$  mm. **Male flowers** with a pinkish pedicel 5-6 mm long; tepals 4, white or pinkish with pink or red entire margin, apex rounded, glabrous, outer two round,  $4.5-6 \times 5$  mm, inner two narrowly obovate,  $4-5.5 \times 1.5-2$  mm; stamens ca 20; stamen cluster sessile, conical, 2-2.5 mm diam.; filaments ca 0.5 mm long; anthers pale yellow, narrowly



obovate, ca 1 mm long, apex emarginate, dehiscing along lateral slits. **Female flowers** with a crimson pedicel ca 2 mm long; ovary crimson or pinky white, ca 8 × 8 mm, wings 3, equal, locules 3, placentas 2 per locule; tepals 5, reddish at the margin, whitish at the base, outer three oval, ca 10 × 7 mm, apex rounded, inner two ovate, ca 8 × 5 mm, apex acute; styles 3, bifurcating with ultimate branches broadly U-shaped, styles and stigmas pale yellow, ca 4 mm long. **Fruits** almost sessile or on a stiff stalk up to 3 mm long, pendent; capsules broadly obovoid, 13-17 × 12-14 mm, wings 3, equal, tapered to the base, slightly angular distally, 2-3(-5) mm wide, thinly fibrous, dehiscing between the locules and the wings. **Seeds** barrel-shaped, brown, ca 0.3 mm long, collar cells three quarters the seed length.

*Other specimens examined:* Borneo, Sarawak, Ulu Merirai, Gua Kenyalang, Julia et al. S 91194 (E, KEP, SAR); Gua Kenyalang, 9 Jul 2005, Leong et al. PL 214 (SAR, SING).

*Habitat:* On sheer limestone cliff faces or on the arch of cave mouths at or above the level of the tree canopy, sometimes fully exposed to sunlight.

*Distribution:* Endemic in Borneo, Sarawak; known from Gua Kenyalang and Gua Aki Bukok in the Ulu Merirai area, Tatau District.

*Notes:* This is an unusual begonia with almost transparent, whitish green, very succulent stems and petioles and round leaves with a raised deep-red broad margin, hence the name 'piring', which means saucer in Malay. The inflorescences are crimson with attractive crimson flowers with a white centre and the ovary is crimson or pinky white. *Begonia piring* can be distinguished from the other peltate limestone, *B. payung* by the following characters (see Table 2).

6. *Begonia rhodochaeta* S.Julia & Kiew, *sp. nov.*

Section: *Reichenheimia*

*A Begonia stichochaeta K.G.Pearce petiolis longioribus 3.5-8 cm longis (nec 0.7 cm), inflorescentiis brevioribus 1-2.2 cm longis (nec ca 3.4 cm), fructibus latioribus quam longioribus et placentis in quoque loculo singulis differt.* – **Typus:** Borneo, Sarawak, Tatau District, Ulu Merirai, trail to Gua Spring, 8 Jul 2005, Julia et al. S 91169 (holo, SAR; iso, E, K, KEP, L, SAN, SING). **Plate 2C-E.**

Rhizomatous begonia, the prostrate stem rooting at the nodes. **Stems**



**Table 2.** A comparison between *Begonia piring* and *B. payung*.

	<i>B. piring</i>	<i>B. payung</i>
Stems	succulent, translucent	not succulent, not translucent
Internodes	12-35 mm long	4-5 mm long
Stipules	broad triangular 8-16 × 4-6 mm	narrowly lanceolate 5-7 × 4 mm
Lamina	whitish green, scintillating	bronzy green when young to mid-dark green
	brittle when fresh	not brittle when fresh
	base projecting 5-15 mm	base projecting 15-25 mm
	margin crimson	margin concolorous
Veins	2 pairs at base, 4 pairs along midrib	3 pairs at base, 1 pair along midrib
Male flowers	pedicels 5-6 mm long	pedicels 10-16 mm long
-tepals	white with red margin	rosy pink
-outer tepals	4.5-6 × 5 mm	6-9 × 6-10 mm
-inner tepals	4-5.5 × 1.5-2 mm	4-10 × 2-3 mm
-stamen cluster	conical	fan-shaped
-filaments	0.5-1 mm long	1.5 mm long
Female flower	pedicels 2 mm long	pedicels 5 mm long
	placentas 2 per locule	placenta 1 per locule
Fruit	pedicels 3 mm long, stiff or almost sessile	pedicels 3-4 mm long, fine and dangling
	capsules 13-17 × 12-14 mm	capsules 7-10 × 5-6 mm
	wings 3, 2-5 mm wide	without wings, with narrow ribs

succulent, dark green, densely bristly, unbranched, erect part of the stem to 10 cm tall and 7-8 mm thick with leaves in a tuft at the top, lower internodes to 1.4 cm long, upper ones touching; without a tuber. **Stipules** green or dark red, narrowly lanceolate, 8-14 × 4-7 mm, midrib densely bristly, margin entire, apex attenuate. **Leaves** spirally arranged, upstanding; petioles dark red when young, densely bristly, bristles brownish, (3.5-)5.5-8 cm long, grooved above; laminae not oblique, plain glossy green, paler beneath, young leaves pink with a crimson midrib, upper surface with scattered bristles between the veins, glabrous beneath, slightly asymmetric, obovate, (13.5-)18-23(-27) × (5.5-)7-10(-13) cm, broad side 3-7 cm wide, concave on the narrower side, base tapering or cuneate, rarely rounded, basal lobe up to 3 mm long, margin red, serrate and scalloped toward the apex, distantly ciliate, apex attenuate, acumen to 2-3 cm long, leathery when dried, margin red; venation pinnate, veins (4-)5 pairs along the midrib, glabrous above, prominent beneath with red bristles, impressed above. **Inflorescences** axillary, deep red from the upper leaf axils, hairs red in life, erect, shorter

than the petioles, protogynous, at first with 2 female flowers produced in succession, followed by slender lax cymes 1-2.2 cm long each comprised of 3 male flowers. Bract pair dirty red, narrowly lanceolate, ca  $7 \times 2-3$  mm, midrib densely bristly, margin entire, apex setose, caducous; bracteole pairs broadly ovate,  $2-4 \times 1.5-2$  mm, margin entire, caducous. **Male flowers** with dark red pedicel 10-26 mm long; tepals 4, white, outside pink toward the base, round, glabrous, margin entire, outer two  $10-12 \times 7$  mm, apex slightly acute, inner two  $10-11 \times 6-9$  mm, apex rounded; stamens 25-30, stamen cluster sessile, globose, ca 3 mm diam.; filaments ca 1.5 mm long; anthers bright yellow, narrowly obovate, ca 1 mm long, apex rounded, dehiscing along lateral slits. **Female flowers** with a dark red pedicel 9-12 mm long; ovary red, broadly ellipsoid,  $11-13 \times 9-12$  mm, wings 3, equal, locules 3, placenta 1 per locule; tepals 5, pinkish, glabrous, elliptic, margin entire, apex rounded, outermost ca  $7 \times 4$  mm, innermost similar but narrower, ca  $7 \times 2.5$  mm; styles 3, bifurcating, ultimate branches broadly U-shaped, 2.5 mm long, pale yellow. **Fruits** maturing on the prostrate rhizome, stalk slender, 12-25 mm long, capsules glabrous, campanulate in outline,  $12-15 \times 13-18$  mm, wings 3, equal, extremely thin, 2-6 mm wide, tapered to the base, angular distally, dehiscing between the locules and the wings. **Seeds** barrel-shaped, brown, ca 0.3 mm long, collar cells more than half the seed length.

*Specimen examined:* Borneo. Sarawak, Ulu Merirai, Pak Danum, *Julia et al.* S 95783 (SAR, SING).

*Distribution:* Endemic in Borneo, Sarawak; known only from the Ulu Merirai area, Tatau District.

*Habitat:* On slopes below the limestone hills on thick black soil or on litter-covered limestone boulders in very wet shaded areas or sometimes epiphytic on trees beside streams.

*Notes:* Superficially, in its non-oblique, obovate leaves it resembles *Begonia stichochaeta* K.G.Pearce from the Subis limestone but it differs in its longer petioles (3.5-8 cm long vs. 0.7 cm), shorter simple cymes 1-2.2 cm long with 3 male flowers (vs. inflorescences to 3.4 cm long with a cluster of many male flowers), longer pedicels of the male flower 10-26 mm long (vs. 7 mm long) and fruit stalks 12-25 mm long (not 5-9 mm long) and capsules broader than long,  $12-15 \times 13-18$  mm (not longer than broad,  $29 \times 18$  mm). While both have three locular ovaries and capsules, *B. rhodochaeta* has one placenta per locule which places it in sect. *Reichenheimia*, while *B. stichochaeta* has two and belongs to sect. *Petermannia*.

It is named for its striking red, bristle-like hairs on the leaf surfaces.

7. *Begonia sarangica* Kiew & S. Julia, *sp. nov.*

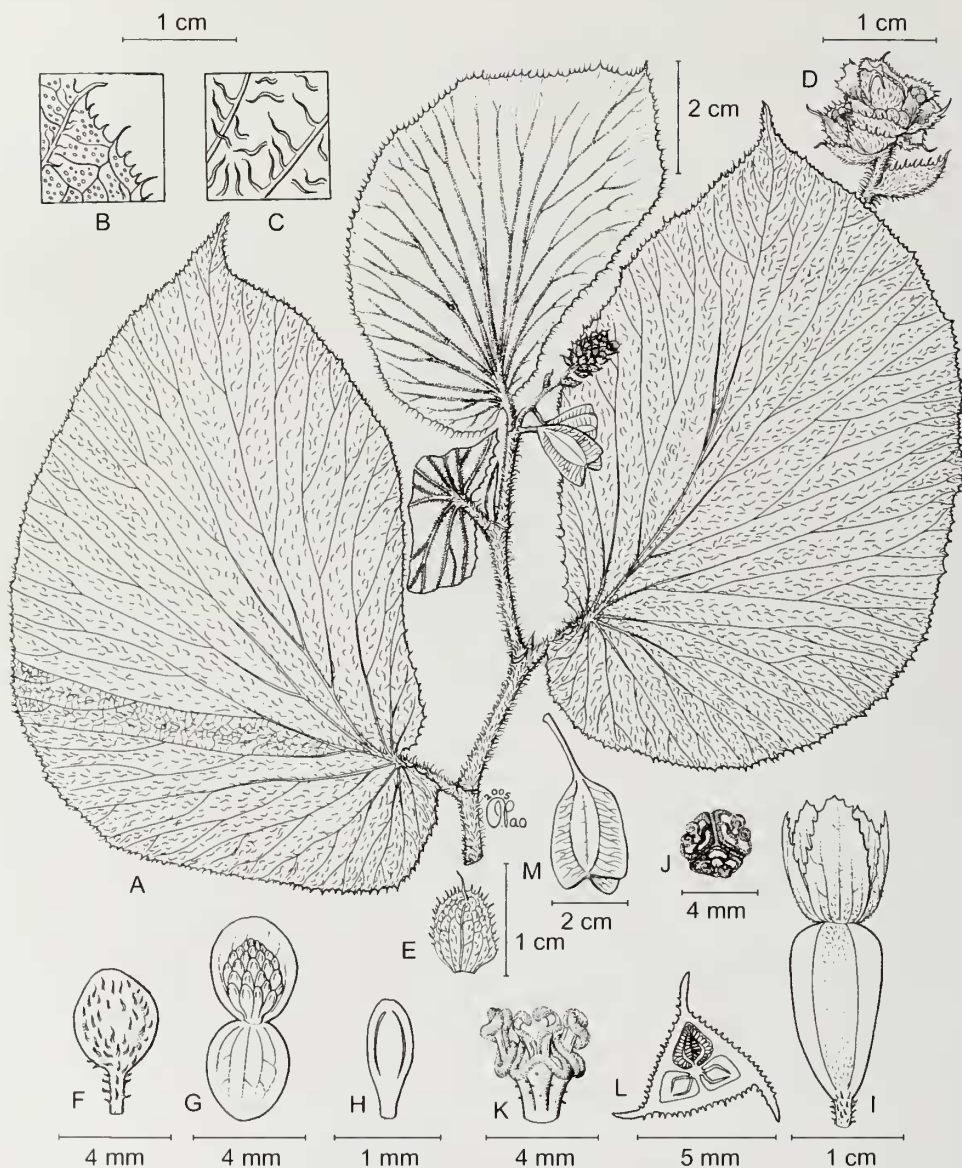
Section: *Petermannia*

*A Begonia corrugata* Kiew & S. Julia *petiolis brevioribus 1.2-2.5 cm longis (nec 4.5-6.5 cm), inflorescentiis brevioribus 4.3-7.5 cm longis (nec 13.5-23 cm) et pedicellis in fructu 4-8 mm longis (nec 10-13 mm) differt.*

—**Typus:** Borneo, Sarawak, Tatau District, Ulu Sungai Kakus, Bukit Sarang, Batu Anyi, 5 Oct 2004, Lee *et al.* SL 39 (holo, SAR; iso, E, KEP, SING).

**Fig. 2.**

Cane-like begonia. **Stems** dark brown, woody, erect, 30-100 cm tall, stout in life and 6-8 mm thick, little branched, nodes swollen, densely bristly with bristles 1-2 mm long, at first greenish, becoming brownish; without a tuber. **Stipules** sparsely bristly, obovate, ca  $17 \times 7$  mm, margin entire, fringed by long hairs, apex acute, caducous, stipular scar conspicuous. **Leaves** distant, held horizontally, internodes 3.5-8.5 cm long; petioles dark brown, densely bristly, 1.2-2.5 cm long, grooved above; laminae slightly oblique, above plain dull, dark green with pale green hairs on the lamina, beneath pale green, corrugate, thin in life, papery when dried, obovate, asymmetric, 11.5-20  $\times$  10-15.5 cm, broad side 6-11 cm wide, base unequally cordate, basal lobes rounded, the larger 1.3-3 cm long, margin minutely toothed, apex slightly acute; venation palmate-pinnate, 5-6 pairs with another 3-4 veins in the basal lobe, veins narrowly parallel, narrowly branching once less than halfway to the margin and again about two thirds of the way to the margin, impressed above, beneath prominent and concolorous tinged purple-brown towards the petiole, densely bristly. **Inflorescences** axillary, reddish, densely bristly, erect, shorter than the leaves, racemose, 4.3-7.5 cm long, peduncles 7-55 mm long, each few-flowered branch arising from a pair of foliose bracteoles, branches 1-4 mm apart with the bracts and bracteoles overlapping the upper ones, with up to 4 or 5 branches, male flowers many, female flowers one or two only from the lowest branch, protogynous. Bracts and bracteoles foliose, paired, pale green, ovate, bracts 15-18  $\times$  8-11 mm, bracteoles 8-12  $\times$  5-6 mm, decreasing in size towards the apex, dorsally hairy and with a distinct midrib, margin entire, apex acuminate and setose. **Male flowers** with reddish hairy pedicels 2-4 mm long, tepals 2, broadly oval to obovate, 5-6  $\times$  3-5 mm, outside deep rosy red, inside pale yellow sometimes rosy red or rosy red and greenish towards the base, minutely hairy outside, margin entire, apex rounded; stamens ca 30, cluster sessile, globose or conical, ca 3  $\times$  2-3



**Figure 2.** *Begonia sarangica* Kiew & S. Julia. A. Habit; B. Leaf surface upper; C. Leaf surface lower; D. Inflorescence; E. Bract; F. Male flower bud; G. Male flower; H. Stamen; I. Female flower; J. Styles and stigmas (top view); K. Styles and stigmas (side view); L. Transverse section of the ovary; M. Fruit. (Drawing by J. Pao).



mm, filaments sessile or up to 0.5 mm long, anthers pale yellow, narrowly obovate, ca 1 mm long, apex rounded, dehiscing along lateral slits. **Female flowers** with a reddish pedicel 2-4 mm long, ovary pale green, oblong, 13-18 × 9-11 mm, wings 3, equal, locules 3, placentas 2 per locule; tepals 5, pale cream to yellow green, oval to oblong, minutely hairy outside, margin minutely toothed in the upper half, each tooth tipped by a hair, apex rounded or slightly acute, outermost 12-13 × 7-8 mm, innermost similar but smaller 8-9 × 5-7 mm; styles 3, ca 5 mm long, joined for ca 1 mm at the base and bifurcating above, styles and stigmas pale greenish yellow, stigmas in a spiral papillose band. **Fruits** held horizontally or downwards at 45°, stalks stiff and thick, 4-8 mm long, capsules (17-)20-23 × (10-)13(-17) mm, minutely hairy on the locule wall, wings 3, equal, thin, 4-6 mm wide, splitting between the locules and wings. **Seeds** barrel-shaped, brown, ca 0.3 mm long, collar cells ca half to three quarters the seed length.

*Other specimens examined:* Borneo, Sarawak, Bukit Sarang, Batu Lebik, Lee et al. SL 105 (E, KEP, SAR, SING); Bukit Sarang, Anderson S 20942 (K, L, SAR).

*Habitat:* On limestone derived soil high on the limestone hill, in deep shade at the base of the summit cliff faces or in saddles, widespread on the two hills but found only as scattered small populations of about 20 plants.

*Distribution:* Endemic in Sarawak, Tatau District; known only from Ulu Sungai Kakus, Bukit Sarang (Batu Anyi and Batu Lebik).

*Notes:* This is one of the cane-like begonias with corrugated leaves and resembles *Begonia corrugata* Kiew & S. Julia not only in its habit and leaves but also in its very small male flowers with tepals that are minutely hairy outside. However, *B. sarangica* differs from this species in its shorter petioles, 1.2-2.5 cm long (not 4.5-6.5 cm long), shorter inflorescences, 4.3-7.5 cm long (not 13.5-23 cm long), and shorter fruit stalk, 4-8 mm long (not 10-13 mm long).

*Begonia sarangica* is named for the locality where it grows. It is unusual in having only one male flower of an inflorescence open at a time.

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